THE MEMBERS MAGAZINE OF THE NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY

Terra

VOL. 15 NO. 2 FALL 1976

Genesis of a Terra Article

Southern California has been blessed by the quality, enthusiasm and creativity of its plant-lovers — amateurs as well as professionals — and as we enjoy our public gardens, handsome freeway plantings and avenues of flowering trees it is interesting to know something of the men and women whose persistence has made these possible.

With this in mind, recently a small "Terra Team," armed with cameras and notebooks, drove south to San Diego county to visit and photograph the magnificent Proteas grown by J. Howard Asper and his son at Green Valley Nurseries near Escondido. Asper made us welcome and we caught his infectious enthusiasm as he guided us through his garden.

Long a figure in Southern California horticulture, Asper joined Armstrong Nurseries in 1927 and remained with them until 1941 when publisher Manchester Boddy successfully lured him away to start and supervise a commercial garden on Boddy's estate in La Canada — a garden called Descanso. Asper planted the first camellias under the great oaks and in time the garden sold ornamental foliage and cut-flowers such as ranunculas, daisies and agapanthus, as well as nursery specimens. And in 1953 when the county bought Descanso Gardens from Boddy to preserve it under the Department of Arboreta and Botanic Gardens, Howard Asper remained as its first Superintendent. He left Descanso in 1954 to join the staff of Huntington Gardens as the superintendent of the buildings and grounds, a position he held until his retirement in 1962.

While still at Descanso, Howard Asper bought acreage north of Escondido and in the mid-fifties when Colorado River water arrived in the area, he began to test the horticultural possibilities of his land. His interest in Proteas had begun at the Huntington, but early efforts with seeds were unsuccessful until 1961 when Dr. Howard Gentry, a plant collector for the U.S. Department of Agriculture, brought him seeds from South Africa. Asper planted these in flats out in the open. They flourished. The long dry summer and the frost-free winters of the area proved ideal. He solved the problem of summer root-rot with fungicide and alleviated that of high summer heat with lath shelters for the young seedlings. In addition, Southern California lacks a long-beaked bird to pollinate the big species of Protea so that it will set seed. This problem Asper solved by buying much of his seed from Frank Batchelor and other South African suppliers.

All in all, it is another happy success for a man acclaimed for his generous service.

Studying Terra

Victoria Kuhns chose magazine production as the topic of her senior project at Marlborough School, an independent secondary school for girls in Los Angeles; TERRA's editors were especially pleased that Victoria chose TERRA as the magazine to study. She worked with us from February through the spring, helping us with TERRA's spring issue from its conception in the form of typed manuscripts, through its growth into galley sheets and layouts, to its birth in handsome magazine form. In presenting her completed project at Marlborough, Victoria used TERRA's boards — the cardboards on which columns of type and photographs or pictures are pasted in final form — to show how magazine production works. Marlborough awarded her Honors for the project, as do the editors of TERRA, who found Victoria quick to learn and full of good humor and efficiency. "It was fun," Victoria remarks, "and I certainly learned a lot." In fact, while reading copy, Victoria found two mistakes in the galley proofs that the editor who prides herself on being a gimlet-eye had missed. TERRA is happy to have worked with Victoria, who, having graduated from Marlborough in June, is now a freshman at the University of California at Berkeley, where she is turning her own eagle eye towards the campus magazine.

The Cover

Protea *compacta*. Armando Solis used a Hasselblad 500 C with a 120 mm Zeiss S-Planar lens and an extension tube to take the cover photo and all other of his pictures for the Protea article.

Terra®

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EDITOR/Dorothy H. Seligman
ASSOCIATE EDITOR/Harry Pack
CONTRIBUTING EDITORS/
Kilbee Brittain/
William A. Emboden Jr./
Gretchen Sibley
DESIGN EDITOR/Frank Page

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MUSEUM PHOTOGRAPHERS:
Armando Solis/Larry Reynolds
STAFF ILLUSTRATORS
Mary Butler/Joseph Nakanishi

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Design, Form and Symmetry:

The Protea Family

by **Robert J. Gustafson** *Photos by Armando Solis*

Protea repens

If you visit the wholesale flower market on Wall Street in downtown Los Angeles you will wander among booths that display big, bold flowers whose spectacular array of colors and forms rivals that of all other exotic species, including the Orchids.

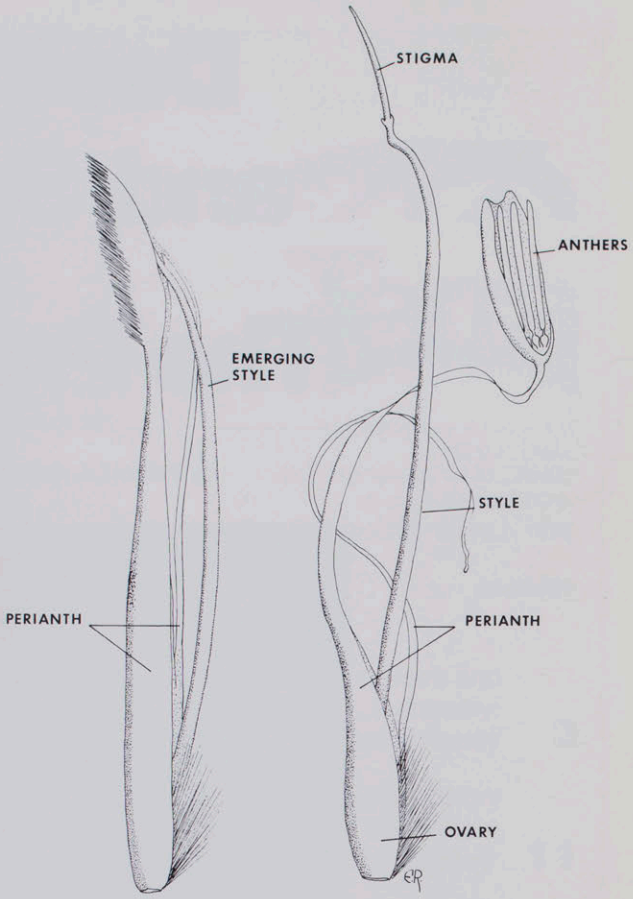
It is possible that you will not recognize them, for these showy members of the Protea family have not been well-known in the United States until recently. Comprised of sixty-one genera and some 1400 species, the Proteaceae are restricted primarily to the southern hemisphere, especially South Africa and Australia.

Now, however, California growers have successfully cultivated *Protea, Banksia, Grevillea* and a few other genera of the big Proteaceae family. Especially, several species of *Protea* have become desirable items in the florist's trade not only because of their exotic appearance but also for their long-lived properties as cut flowers. They are beautiful for a week or more, and then, when deprived of water, gradually dry into interesting arrangements.

Since the family is so well represented in South Africa and Australia, support is given to the theory that these two land masses were linked at sometime in pre-history. However, the genera do not overlap; those indigenous to Africa are not found anywhere else in the world, while the Australian representatives are primarily restricted to that region. Members of the family are also found in Chile, New Caledonia, New Zealand, Polynesia, Madagascar, tropical Asia and Malaysia. The great majority of these plants live in regions where there is annually a long dry season, which probably accounts for the fact that many are assymetrical in their growth form. Nearly all are shrubs or trees with entire or finely dissected leaves, usually with a thick cuticle and an additional covering of hairs to prevent transpiration.

The Proteaceous flower is a bi-sexual (except in *Leucadendron)* symmetrical or asymmetrical plant in which one segment of

Protea repens shrub (winter blooming)



PROTEA FLOWER

the tubular outer envelope of the flower separates from the other three fused lobes when the flower opens. Four stamens, the male organs, are located opposite these lobes in spoon-like depressions; a simple style arises from a superior ovary. There are no petals, only four petal-like segments. Individual flowers are often arranged in a showy bracteate head or they may be in spikes. The fruit is highly varied, bearing one to few seeds which may be winged.

In South Africa most of the species are restricted to the southwest Cape where they become one of the dominants in an evergreen vegetation known as "fymbos," just as certain species of plants comprise "chaparral" in California. *Protea* is the second largest genus with approximately 150 species and by far the most spectacular, producing some of the most unusual flower heads in the plant kingdom.

The French botanist Clusius described and illustrated the first protea in 1605, but it was not until 1735 that Linnaeus named the plant after the Greek god Proteus, who was capable of changing himself into many shapes. And there is, indeed, a great variety in this genus. When Clusius examined *Protea neriifolia,* he mistakenly referred to it as a kind of thistle, which was thought to have originated in Madagascar. It became the first native South African plant to be recorded in literature. Today it is recognized as South Africa's national flower. In the late eighteenth century many plant collectors were sent out from Europe to build up collections of rare plants and high in priority were several species of proteas. Cultivation of these plants, especially in their native land, has contributed much to popularizing them among gardeners and florists alike. Many species which are rare in nature have been successfully propagated by nurserymen, thus insuring their preservation.

The largest flowerhead in the genus, *P. cynariodes,* which derives its specific name from its resemblance to a giant artichoke, has an inflorescence up to twelve inches across. However it is a comparatively small shrub considering the size of the bloom. It rarely exceeds five feet at maturity. Rivaling *cynaroides* not only in size but also in form is the spectacular beauty of *P. barbigera,* which must be seen to be fully appreciated. Resembling a gigantic powder puff, the flowers may vary in color from a soft pink to a pale yellow or cream. "Sugarbush" is the name imparted to *P. repens* because of the sweet nectar from the flowers which is made into a syrup, *Syrupus Proteae,* used for coughs and pulmonary infections. *P. neriifolia* with leaves like those of an oleander attracts much attention because of the furry black or purplish beard at the tips of the satiny pinkish bracts. "Waboom" *(P. arborea),* so named because the early colonists in South Africa used its wood to make wagon wheels, is a tree achieving a height of twenty feet.

"Pincushions" *(Leucospermum)* comprise about forty species mostly from the southwest Cape but with a few from Transvaal, Natal and tropical Africa. The "skyrocket plant" *(Leucospermum reflexum)* is a spectacular shrub in flower with its soft gray foliage topped by masses of orange-scarlet. The flowers reflex as they mature, and the showy crimson style emerges by springing out of the tube and curling backwards and downwards giving the impression of an ignited rocket. *L. nutans* produces scores of dome-shaped flower heads in shades of pink, yellow and orange on a low spreading bush, about five feet tall and equally broad. The large globular heads of *L. catherinae* resemble a golden pinwheel with the extended stigmas all turning upwards as the flower matures.

Leucadendron with seventy or so species from the southwest Cape includes

Protea cynaroides bud and opening flower

Protea cynaroides mature flower *Photo by Dorothy H. Seligman*

Protea neriifolia

Protea neriifolia dried flower

Protea scolymocephala

Protea obtusifolia

those shrubs known as "Gold-Tips" and the famous "Silver Tree" *(L. argenteum)* for which the genus was named. The latter ranks as one of the most beautiful trees in the world with its grayish-green leaves covered with fine silvery hairs that seem to scatter the light that falls upon them. Male and female flowers appear on separate plants, the former is a yellowish ball of stamens, while the latter is a gleaming silvery cone, which is wind pollinated. In other members of this genus, male plants may be quite different in habit than the female of the same species, but usually the difference is confined to the flowering parts. In both sexes the flowers are surrounded by a group of brightly colored bracts (especially in the female) as in *L. discolor* and *decorum.*

Other genera of the family from South Africa that find their way into cultivation are *Paranomus, Serruria, Mimetes* and *Brabeium* to mention a few. Fortunately, several Proteaceous plants have found their way into California horticulture and have successfully been brought into flower. But the requirements for continued growth are not always easy to meet, making them real challenges for the experienced as well as the amateur gardener.

The Australian representatives are as equally spectacular as their African counterparts. Some thirty-five genera and 800 species are concentrated on this continent, notably *Banksia, Grevillea, Hakea, Dryandra* and *Isopogon.* In Western Australia this family forms a dominant part of the flora where the land surface is one of the most ancient on earth and where the plants have had an unusually long and undisturbed development. Since isolation is a necessary ingredient in the evolution of new plant species, the great diversity in the Proteaceae in Western Australia is due in large part to this factor. The vast deserts of central Australia have been reponsible for the unique features of the western wildflowers that make them distinct from those of the east.

Banksia, named for Sir Joseph Banks who played an important part in the botanical history of the Pacific, is the third largest genus in Australia with sixty-five species ranging in size from low shrubs to small trees. Flowers are massed in cylindrical, conical or spherical heads, which are devoid of surrounding bracts at their base. The fruit is curious, being a large, woody, cone-like structure. Banksias are largely bird-pollinated, but they also almost solely support the tiny marsupial honey-possum of southwest Australia. This diminutive mammal has become thoroughly adapted to a diet of nectar, which it imbibes from these flowers and also from those of bottlebrushes. Two other marsupials, the pygmy possum and the dibbler, and a small native rat also feed extensively on banksias. During the summer months in this region the abundant nectar of these flowers would be the only water source for bird and animal life. Perhaps the success of the genus is due in large part to its ability to attract a wide variety of pollinators.

Grevillea, a large genus of 160 species with representatives in New Caledonia and Celebes as well as Australia and also the largest genus in the family, are mostly small

Protea barbigera

Leucodendron discolor (male)

Grevillea robusta

Leucodendron argenteum (male)

Isopogon cuneatus

Paranomus spicatus

Banksia praemorsa

Banksia baxteri seed pod

shrubs to very large trees. "Silk-oak," *Grevillea robusta,* so named because of the silky, oak-like grain of the wood, is a tall tree planted all over Southern California bearing bronzy-orange, comb-like inflorescences in the spring that may cover the entire tree. Its wood is highly desirable for cabinetwork.

Self-pollination is circumvented both in *Grevillea* and *Banksia* in a most interesting manner. As the flower opens, pollen is displaced from the anthers onto the outreaching style tip, not yet receptive, to be brushed away onto bird plumage. When the stigma has matured, it will hold tiny grains of pollen, which have been brought in by birds from neighboring plants of the same species. Thus pollen is both dispensed and received from a minute portion of the flower, separated only by time. Since birds must hold their heads at the same angle each time they sip nectar, pollen is accurately placed and received, insuring a good chance of cross-pollination. The flowers are also capable of self-pollination in the event that no pollinators appear. This is the ideal evolutionary system.

Other members of the family that are encountered in cultivation include *Isopogon* with thirty species confined to Australia, the pink-flowered forms often named "Rose Cone Bushes"; *Stenocarpus sinuatus,* "firewheel tree," a medium-sized tree from Australia with bright red flowers in the shape of a wheel and leaves approximately those of an oak; *Knightia excelsa,* "New Zealand Honeysuckle," a tall columnar tree from New Zealand with deep reddish-brown flowers covered with a velvety tomentum; *Hakea,* with one hundred species endemic to Australia, generally shrubs occasionally becoming somewhat arborescent and frequently encountered in cultivation in Southern California *(Hakea laurina,* "sea-urchin," a particularly attractive and widely-planted shrub); and *Telopea oreades,* "Victorian Waratah," a spectacular shrub or tree from Australia with gorgeous red flowers that is extremely difficult to cultivate but well worth the effort.

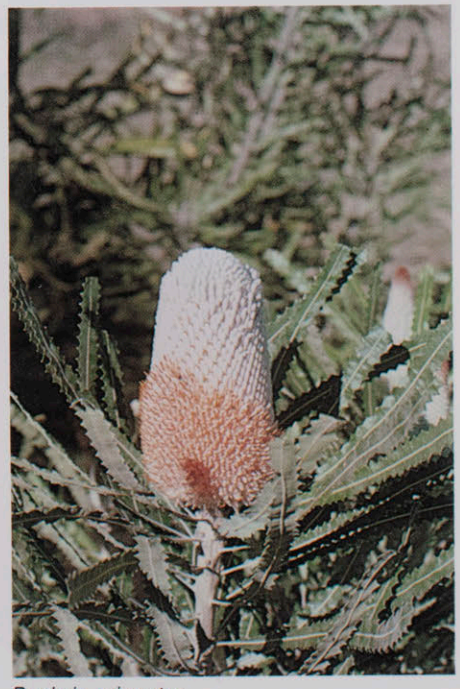
Economically speaking perhaps the most important member of the Proteaceae is *Macadamia ternifolia.* This medium-sized tree bearing long spikes of small white flowers yields the well-known macadamia nuts. In the Hawaiian Islands several thousand trees were planted in hopes of turning production of the nuts into a profitable market. Today it has become a minor industry. The nut itself, which somewhat resembles an almond or hazelnut in both flavor and consistency, contains about 70% fat and is a good source of vitamin B1, calcium, phosphorus and iron; seven of these nuts yield about as many calories as a slice

Banksia ashbeyi

Banksia speciosa seed cone

Photos page 9 by Dorothy H. Seligman

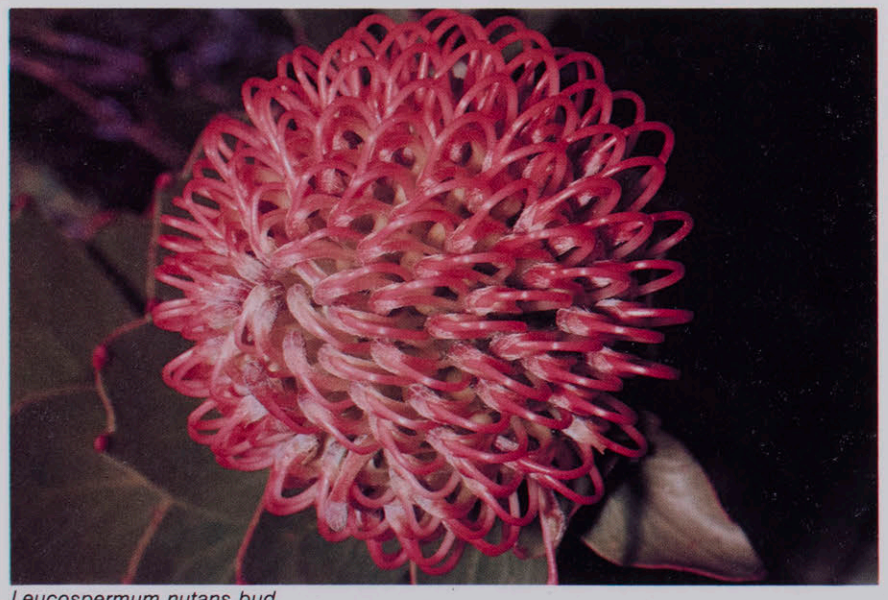
Banksia integrifolia



Banksia prionotes

Leucospermum grandiflorum

Leucospermum reflexum



Leucospermum nutans bud

Macadamia nut tree flowers

and a half of bread. The wood of the tree, which is fine-grained and reddish is desirable for cabinetwork. About fourteen species of *Macadamia* are scattered from Australia to New Caledonia, Celebes and Madagascar. Other species yield edible nuts, but the quality is definitely inferior to those of *M. ternifolia.*

It can certainly be argued which family of plants produces the most exotic flowers, but one is hard pressed to find a group as diverse and exciting as the Proteaceae. Although many of them are largely unknown in North America, they are becoming a more familiar sight especially in parts of California where the climate closely approximates their natural habitat. Cultivation of these floral wonders presents some real challenges to the grower, but it is hoped that one day the seemingly elusive *Protea* will be a common sight in our gardens.

Robert Gustafson, Assistant Botany Curator at the Natural History Museum of Los Angeles County, has long had a fascination for unusual plants like the Protea. He has collected many such oddities in his travels through the New World tropics.

A brief history of the unicorn and "unicorning"

by **William A. Emboden**

Unicorn — A fabulous animal resembling a horse with one horn.

Webster's Dictionary

Some fables are interesting merely because they form the substance of stories that amuse or provoke flights of fantasy. An exception to this is the mythology of the unicorn. The unicorn legends have profoundly affected art and literature including the Bible. Indeed unicorn legends most likely had their origins in the Bible.

In the third century a group of seventy scholars sought to translate the Old Testament from Hebrew into the language of the day, Greek. The Septuagint ran into a number of problems that were not merely philological. Mention is made in the Hebrew version of the Old Testament of kinds of animals totally unfamiliar to the Greeks. Frequently a plant or animal would be mentioned without any attendant description, leaving the puzzled scholars with no alternative but to invent the animal. So it was with the *re'em.*

It is somewhat strange that none of these individuals had seen the urus, a wild ox now extinct, which then inhabited the northern Alps and had been seen in the Hercynian forest as an immense and frightening beast. It was not so grand as descriptions by the Romans would lead us to believe, for many zoologists now maintain that the urus was the progenitor of many of our domestic bovines.

Certainly a body of seventy scholars must have had some animal in mind in formulating their *monokeros* (the Greek conjugate for *re'em*). Most likely they consulted the writings of Ctesias, a Greek historian and personal physician to King Artaxerxes II of Persia. Returning from Persia around 398 BC, Ctesias wrote extensively on those countries he had visited, and some he pretended to have seen. Although we do not have the complete texts of these original manuscripts, fragments and abstracts remain. Concerning India he had many exotic tales richly embellished (a euphemism for prevarication). How could one help but be intrigued by wild asses larger than horses with red heads, blue eyes, and on their heads a horn white at the base, black in the middle, crimson at the tip, and about one-and-a-half feet in length? He went on to state the virtues of this horn: when pulverized it was a superb antidote to poison; and if made into a drinking vessel no toxin however powerful could overcome a draught of water or wine taken from the hollow horn. Certainly the *monokeros* (or in the Latin vulgate *unicornus*) must have been derived from some manuscript version of the text of Ctesias concerning a land neither of which he had seen.

The unicorn in Kew Gargens.

Photo by Robert Gustafson

The *re'em* appears in seven different places in the King James Bible as "unicorn." Allusions are made to great strength of the animal:

"Will the unicorn be willing to serve thee, or abide by thy crib?
Canst thou bind the unicorn with his band in the furrow? Or will he harrow the valleys after thee?
Wilt thou trust him, because his strength is great? Or will thou leave thy labour to him?
Wilt thou believe him, that he will bring home thy seed, and gather it into thy barn?

Job 39: verses 9-12

The discovery of the true identity of the *re'em* was made by consulting Assyrian texts in which *rimu* appears as a cognate along with an illustration of the urus (*Bos primigenius*).

Fortunately the true identity of the unicorn was late in coming or it would have destroyed the remarkable legend, art, and history that surrounds it. It is also easy for the contemporary biologist to identify the "wild ass of India" with the one spectacular horn as being a rhinoceros. The gait of the animal and the virtues associated with its one horn (which is incidentally an amalgamation of hair, not bone) are consistent with the text of Ctesias except the horn was not used as an antidote to poison but to promote virility. It is corroborated by the fact that it was a common practice to paint these horns red, black and white for shamanistic and magical purposes. While a mutant form of an ox or a black buck might be a credible hypothesis, the rhinoceros explanation is the most plausible.

Even the characterization of Ctesias is not to be too highly criticized, for we know that he did have the opportunity to see the bas reliefs and friezes on the Royal Palace at Persepolis where the urus is shown in profile so characteristic of Egyptian, Assyrian and Babylonian art. It must be remembered that our concepts of perspective in art as it is now known in the western world did not manifest themselves until the late 15th century. Thus, copies of the urus from these temples indicate only one horn. This may be explained in another way as well: by the time the bas-reliefs were executed (cir. 600 B.C.) the urus was already extinct and artists had to copy other designs or rely on descriptions of a beast that was already a subject of much exaggeration.

When Pliny wrote of the unicorn, he

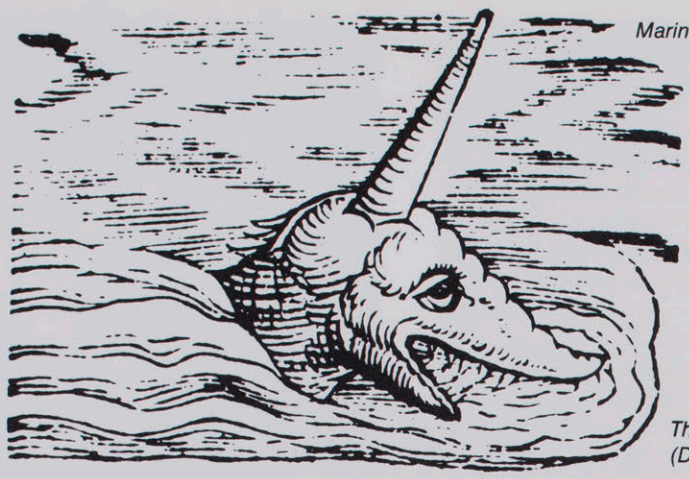
probably had reference predominantly to the Roman writer Aelian who, writing in Greek, referred to an animal in the interior of India which "is the unicorn." It was as large as a horse with a mane, tawny hair, feet like an elephant, and a tail like a goat. He was doubtless also trying to characterize the rhinoceros. Pliny (Plinius secundus) was not one of the great naturalists but one of the great encyclopoedists of the first century. He did make the addition of a "Stag's head" on this creature and added that it had one black horn in the middle of its forehead and that it could not be taken alive.

Julius Solonius in his *Polyhistoria* added considerably to the testimony of all of his Roman predecessors asserting that the unicorn was a monster that bellowed (Pliny maintained that the creature made a deep lowing voice), and that the horn on its forehead was four feet long, bright, and penetrating. Successive generations exaggerated the lore. The Arab world wrote of the unicorn enjoying skewering elephants with its horn. After successively impaling four elephants on its horn, it became immobile and was destroyed by the *roc* (a fabled bird that carried away elephants *in toto* to feed its young).

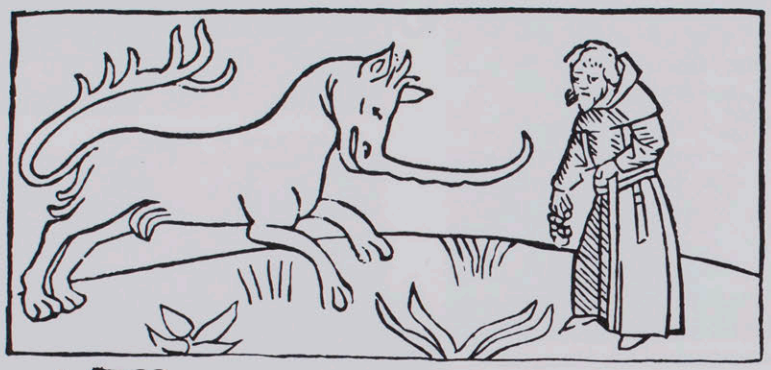
The Semitic peoples frequently told unicorn stories, and it is difficult to believe that they did not take great delight in these. One of these states that the unicorn was too large for the ark during the great flood and was forced to swim during the entire period of inundation and occasionally was permitted to rest its long horn upon the ark!

An element common to dragons, unicorns, and toads was that precious stone that was supposed to be in the skull, or in the case of the unicorn, at the base of the horn. It was a ruby or "carbuncle" that the unicorn bore. Who is going to remember? Amfortas, King of the Holy Grail, had a wound which could be cured only by the precious "male carbuncle stone" (Eschenbach's version). Many writers, even in the renaissance, used the unicorn only as a literary device. It would be easy to ascertain that Shakespeare, while aware of these tales put no stock in them. Brutus, speaking of the gullibility of old Caesar says, "He loves to hear that unicorns may be betrayed with trees." In the fin-de-siecle, that titillating artist, Aubrey Beardsley, wrote his only prose piece, *Under the Hill,* in which Abbe Franfreluche finds a pamphlet entitled "A Plea for the Domestication of the Unicorn," but such a book as that of Beardsley is reserved for the delection of a perverse few.

By contrast, in early Christian iconography Saint Ambrose is credited with the statement: "Who is this Unicorn, but the only-begotten Son of God?"



Marine Unicorn or "Nar-whale."



The Unicorn and the Monk (Dialogus creatorum).

Killing a Urus, from Conrad Gesner's Historia Animalium. (Zurich, 1551)

Saint Basil found the unicorn more like the Almighty God in his unconquerable nature. This was a prevalent concept from the Third Century until the reformation. The origins of this are probably derived from pre-Christian emblems of solitude, virtue and strength (it was sometimes depicted as the substance of the cross of Christ at a later date). The church of St. Fulda maintains a staff reputed to be that of St. Boniface upon which a unicorn knelt at the base of the cross during Christ's crucifixion! Leonardo da Vinci put a swift end to such romanticism with the unicorn portrayed as intemperance.

Marco Polo was somewhat disillusioned when while traveling in the East he found that "they have large numbers of unicorns" and his accurate description indicates to us that the rhinoceros was being called a unicorn. He found that it was possible to capture a unicorn by means other than that reported in the West — that is, for a virgin to go out by full moon in search of the beast which would, enamoured of her, place its head in her lap and promptly fall asleep. Since one was never captured in this manner we must assume that there was either an absence of unicorns, or an absence of virgins (or both). The Freudian implications of the myth are too overt to discourse upon.

According to the French writer De Thaun

"The Rape of the Unicorn" by Gordon Craig.

Reconstruction of a supposed fossil unicorn from the Protagea of Leibnig.

the unicorn was not so easily lulled to sleep as one might think. The virgin who was to be "unicorn bait" had to have one breast exposed which the unicorn would kiss before going to sleep. The English historian Topsell wrote of a more ingenious mode of capture. "They take a goodly, strong, and beautiful young man, whom they dresse in the Apparell of a woman besetting him with divers odoriferous flowers and spices . . . the Unicorne deceaved with the outward shape of a woman, and sweete smells, cometh to the young man without feare, and so suffereth his head to be covered and wrapped within his large sheeves, never stirring, but lying still and asleepe, as in his most acceptable repose. Then, when the hunters, by the signe of the young man, perceave him fast and secure, they come uppon him and by force cut off his horn." This early account of entrapment using the transvestite technique omitted any mention of exposing a breast, most probably because Edward Topsell was a man of the cloth.

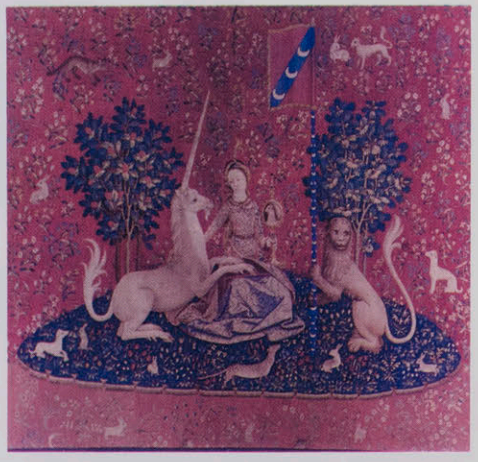
Why pursue a unicorn anyway? One reason other than severing the horn as a medicant and anti-venom vessel was to have the creature alive to dip its horn in contaminated wells and such. A most useful beast. At table the creature had but to touch the food of a sovereign and if poison were present it would instantly become evident. The French called the beast *"la licorne"* and from this the horn became known as *"alicorne."* Many an apothecary found it in his interest to stock alicorne which was literally worth its weight in gold. Soon there became a taxonomy of *alicorne* or *unicornum* (as it was also known). The true *unicornum* came from tusks of mammoths long dead, while the false *unicornum* (still saleable) came from the tusk of the aquatic mammal the male narwhal. The latter found its way into decorative art. The Danish Royal Throne was constructed of Narwhal tusk.

By the time of the Renaissance, *alicorne* was so entrenched in medical practice that it became impossible for a responsible physician to deny his patients the unicornum if he was asked for it. Many prescribed the tusk with little confidence in its value, but with either a profound confidence in placebos or with the profound desire to extract a fee. The material continued to be used even though it was often nothing more than broken or pulverized bone or any animal horn, and the practice continued for centuries.

Since the precious unicorn horn usually appeared only as a powder or shavings, it was necessary to ascertain it to be the true *alicorne*. This could be accomplished by placing the *alicorne* on a piece of pure silk and placing the material on a burning coal; if the *alicorne* were true the silk would not burn. Incredulously, this experimentation seems to have gone unchallenged, for it would have cast doubt on the wisdom of the Ancients. Even the Reverend Topsell was reluctant to say that he did not believe in unicorns, and preferred to leave the reader the freedom of his own judgment. He stated that he could not omit a discussion of the unicorn, for it had been written of since the time of Tsetzes (1110-1180) and "all writers doe most constantly beleeve it".

Only a potentate could afford the alleged unicorn horn. When Catherine de Medici married the Dauphin of France, Pope Clement VII (Catherine's uncle) gave Francois Premier (the bridegroom's father) a piece of "true" *alicorne.* This was a gift worthy of a pope and a king. During the reign of Elizabeth I, an inventory of royal possessions indicates that Elizabeth owned one of these horns carved into a cup. Subsequently it was given to James I who presented it to Queen Anne of Denmark. This was not to be confused with the famous Windsor Unicorn Horn which was eight and a half spans (seventy six and a half inches) in length and valued at ten thousand pounds. It was reputed to have been found on Frobisher's strait in 1577. In 1641 the Marquis de la Ferte' saw a unicorn horn in the Tower of London which was covered

A Unicorn from Albertus Magnus, De Animalibus. Rome, 1478)



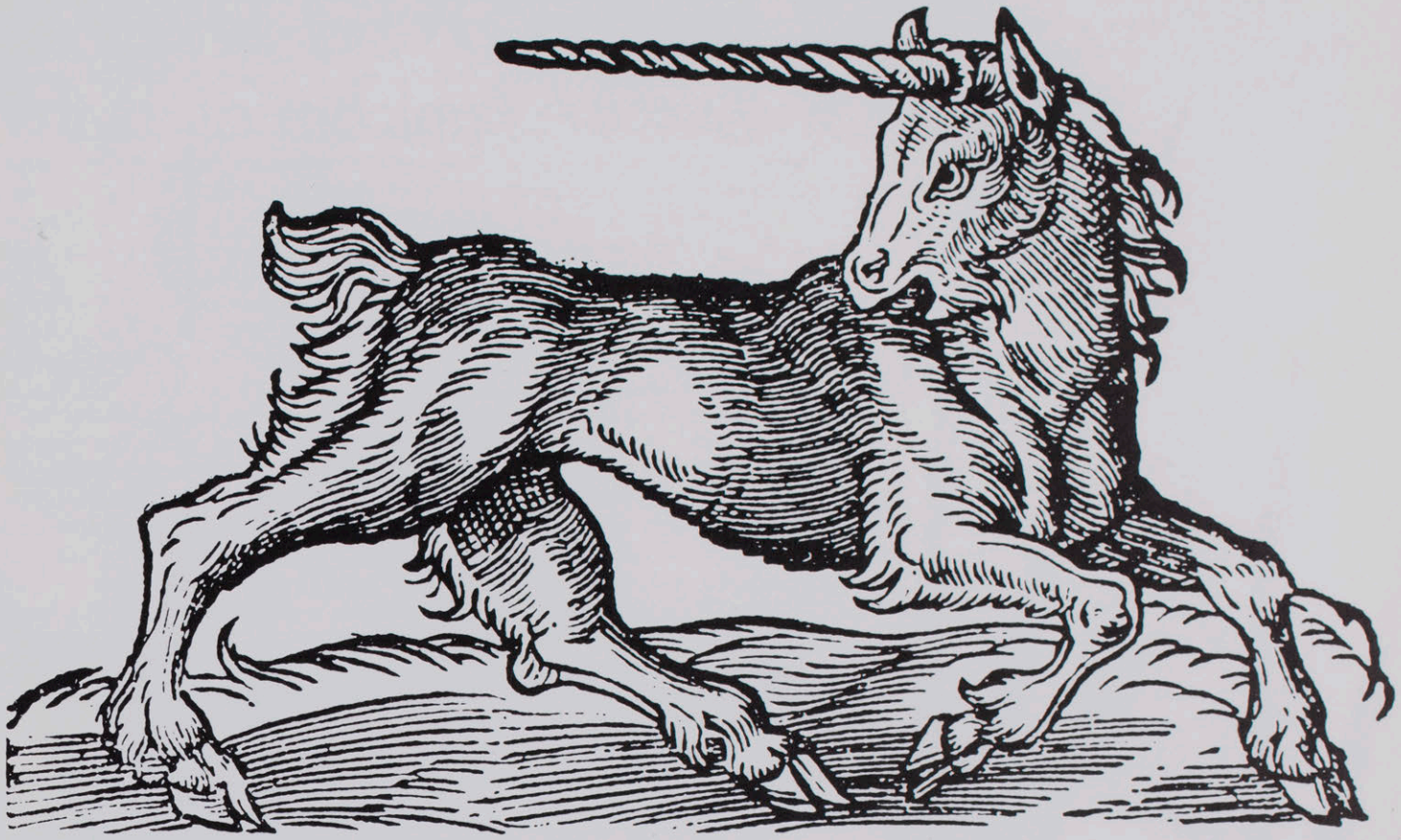
"The Virgin and the Unicorn" from the Cluny Museum tapestries, Paris.

with plates of silver. His estimate of its value was forty thousand pounds (in terms of dollars at this time it would be about two and a half million dollars!) It is interesting to contrast this sum with the price of narwhal tusks which now sell for about one hundred dollars a foot when they appear on the market.

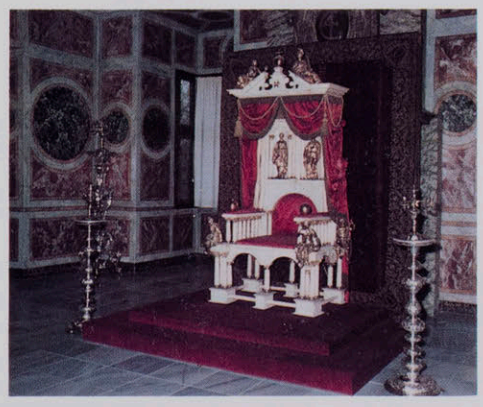
In 1895 in Siberia a dig produced the skull and bones of an extinct relative of the rhinoceros and this was taken as being the remains of the true unicorn; the horn was even located in the center of its forehead. This creature named *Elasmotherium sibiricum* was thought at that time to have been exterminated by man in quest of the horn. A few decades later the French biologist Cuvier challenged the myth, but there is no evidence that it was put to rest.

Dr. Odell Shepard in 1930 published a volume entitled *The Lore of the Unicorn* in which this mythology is exactingly presented (the work has enjoyed a series of reprintings) but in addition Dr. Shepard spoke of one horned sheep in Nepal and unicorned bovines among the Kaffirs and the Dinkas in Africa. Among the Dinkas it was known that they had some mysterious process for "unicorning" and that these one horned beasts were made leaders of the herds. Shepard suggests that the offering of a unicorned ram's head to Pericles by his farm people was a symbolic offering of perfect leadership on his part.

In 1932 an American biologist by the name of Dr. Dove contested the notion advanced by Cuvier that a unicorned animal could not exist because there was a suture between the frontal bones of the skull, and a horn could not grow there. What Cuvier failed to consider was that the horn core does not grow *from* the skull, but *upon* it and originates in "horn buds" which are in the



A Unicorn from Albertus Magnus, De Animalibus. (Rome, 1478)



The "unicorn" throne of Denmark, made of narwahl tusks.

frontal tissue covering the skull. To verify this he produced a unicorn of sorts. A day-old Ayrshire calf had the two horn buds beveled flat at their point of contact and they were then drawn over the central suture. As the horn grew, it did not take on the characteristic recurved form of Ayrshire cattle, but grew in a straight line turning up only at the tip. It was grey-white tipped black, and was firmly attached to the frontal bones (suture not withstanding). Curiously, the animal learned on its own to use the horn to advantage. Anthropomorphising, Dr. Dove stated, ". . . to invert the beatitude, his ability to inherit the earth gives him the virtues of meekness." One assumes that Dr. Dove must have become very attached to his creation.

How long has "unicorning" been going on? We know that Pliny writes of splitting the horn buds and separating them to achieve multihorned animals. Had the peoples of India and Africa been doing something similar at an earlier date to produce a sort of unicorn?

It matters little except we would have been without the ravishing Unicorn Tapestries of the Cloisters of the Metropolitan and the Cluny in Paris and all of the fun that is engendered by any fantastic beast that challenges man's limits of credulity.

William A. Emboden, biologist, botanist, writer, traveled to Europe this past summer on the quest of material for a number of projects in the works. Luckily for TERRA readers, this article about unicorns was one of them.

THE ARABIAN ORYX

unicorn of myth?

When God commanded Noah to build an ark and take onto it the male and the female of all beasts and fowls and everything that creepeth upon the earth, Noah did so. *(Genesis 7:8,9).* He took all animals but one, the unicorn.

The legend of the unicorn is a colorful and elaborate mythology and until recently it seemed that the unicorn was destined to remain just that — a myth. Then explorers and travelers saw the Arabian Oryx. In profile its two horns appear as one. The resemblance to the mythical animal is almost exact. The fabled unicorn's counterpart was living peacefully in the desert wastes of Arabia.

But the search was not over, nor was this animal living peacefully. In fact, the Arabian Oryx is near extinction, threatening to disappear as certainly as did its predecessor who failed to board Noah's Ark. How the Oryx arrived on the Arabian peninsula begins with its history millions of years ago, when it migrated from its home in Eurasia — most choosing to live in the savannas and hills of Africa. However, one type remained behind in the land we know today as the Arabian Peninsula.

The Arabia of millions of years ago provided a very hospitable climate for the Oryx. He thrived and multiplied into great herds; it was a veritable Eden until a great change came. Over the milleniums this fertile land and its water dried up. Great cities vanished almost overnight. The great trade routes moved to the sea. But, ever wandering with their herds of camels and sheep following the seasons from grassland to water hole and back again, Nomadic Bedouins found the only way of life possible in this great desert.

It was inevitable that the paths of the Bedouin would cross those of the Arabian Oryx. Part of their folklore is a legend that says that the hunter who stalks and kills a wily animal inherits its strength, speed and cunning. The Bedouins would pursue the Oryx with spear and camel. It was man against animal, but the speed and stamina of the Oryx made it an equal contest. As late as 1800, it could still be found in large numbers throughout the Arabian Peninsula. But then came the twentieth century. Once again times have changed and man adjusted to his environment much more efficiently than the Oryx. The scale is now out of balance.

Man armed with his tools and his modern technology came into the desert. Strange new giants invaded the most remote regions of what is called the "empty quarter," the last homeland of the Oryx. Jeeps and machine guns replaced camels and spears as man resumed his hunt. As many as three hundred vehicles churned up the desert in relentless pursuit. The Oryx was hardly equal to the contest. By 1962, it was estimated that fewer than thirty-five Oryx remained alive in the world. The species appeared to be doomed. It's impossible for an animal to restructure its own environment and save itself — but man can save him.

Reports of the plight of the Oryx aroused the concern and sympathy of thousands of people in Europe and America. Most had never even heard of the animal before. Sir Peter Scott of the Fauna Preservation Society, one of the world's foremost naturalists, wrote in London newspapers of the desperate situation faced by the Oryx. His plea raised thousands of dollars and mobilized a worldwide crusade. The World Wildlife Fund, the London Mail, and the Fauna Preservation Society pooled their resources to rescue the Oryx. Their only hope: to take the Oryx out of its hostile environment and move it to a safer setting. It was the beginning of Operation Oryx.

The project faced some formidable odds. First, the finding and capturing of enough Oryx to build a breeding herd. Second, their transfer to a safe environment where they would feel sufficiently at home to breed. And finally, negotiations with governments, zoos, and societies to comply with importation and animal regulation laws.

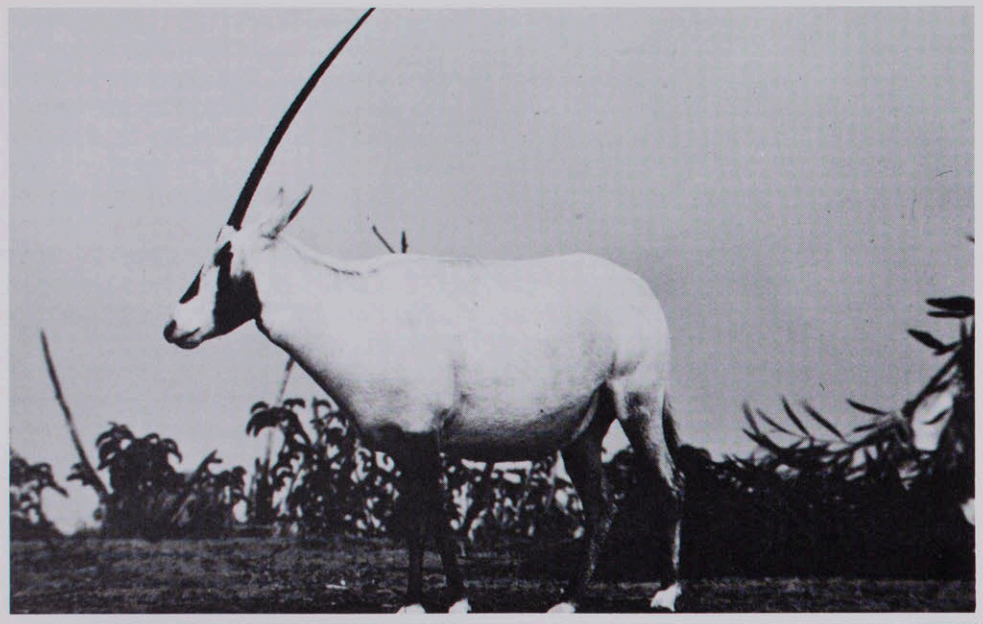
Ian Grimwood, chief game warden for Kenya, led a seven-man expedition into the barren wastes of the appropriately named Empty Quarter of the Rub Al Khali desert in South Arabia. Major Anthony Sheperd, who was also with the expedition, tells the story of the search and capture:

"In the spring of 1962, members of the expedition started to assemble in Aden in South Arabia. Some came from Kenya, one from Britain, the rest of us were already in Arabia. In late April we moved from Aden to Mukulla, an East Aden protectorate, where the authorities had offered us a resort of logistic assistance. We passed through Ceyoon, capital of the Kafari sultanate, where the sultan's palace dwarfed those of the merchants who'd grown rich in Africa and Asia and had returned to live in comparative luxury. From this point on, the expedition must be self-contained, carrying everything that we'd need. The availability of water becomes the all determining factor. The sources of water will chart our course across the desert. The land is flat, empty, and completely without water. Fortunately, this kind of terrain, unlike the areas of sand we struggled over, permit fast travel, but they're still hard on the vehicles and we had numerous breakdowns. Four hundred miles from the start of the trek at Sanau, a base camp was established near an Hadhrami Beduoin Legion fort, next to a well containing the last available water for 150 miles. Supplies and critical repair parts were ferried in by our light spotter aircraft borrowed from the East Africa Wild Life Society. It's a link to the world outside, something quite different from the camels and the goats on which the tribesmen are dependent. A platoon of Hadhrami Beduoin Legion soldiers were stationed at the fort to give protection to the expedition against the possibility of attack by armed raiders. We knew that these people would be the last that we would see until the expedition had become either a success or a failure.

"Eighty miles from Sanau an advance camp was set up in the wadi Mitam. Operation Oryx went into its final stage. Several crates were built to hold the captured animals, that is if we ever found our illusive unicorn. A truck had to replace the specially built catching car which broke down and was abandoned near Ceyoon. A hole was cut in the roof and lined with tire rubber. This prevented serious injury to the man on lookout during the chase. As it was, the expedition leader broke some ribs when the truck hit a bump. We used a plane to look for signs of vegetation where rain might have fallen in the last few years, and which would attract the Oryx. The guide was a tribesman called Tomatum. He had never flown before but he took to it like a duck to water. Each day before first light, the ground party headed into the emptiness to continue the relentless search. We looked for tracks — the distinctive horseshoe-shaped tracks of the Oryx. The Beduoin are masters at finding the spoor and distinguishing its age, even over country like this. In one vehicle, our number two guide was following tracks while the vehicle was still in motion.

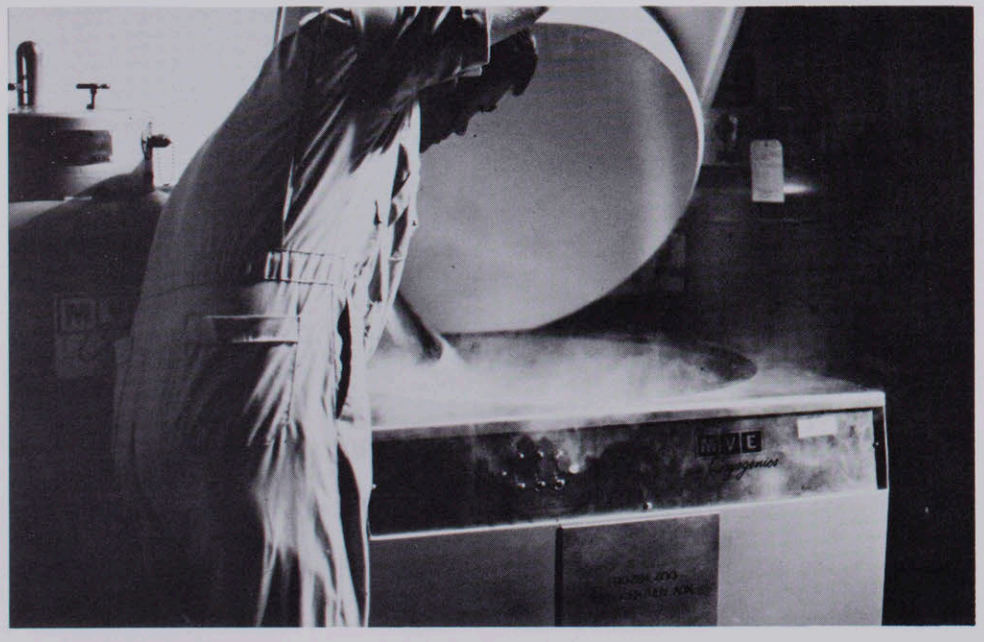
"Suddenly it looked as if something had been found. He got out and was joined by Michael Crouch, the deputy leader of the expedition. It was definitely an Oryx track, one could see the horseshoe shape. It was a moment of great excitement, because not only had we found a track, but a comparatively recent one. This at least proved that the Oryx was still alive. A part of the skull from an Oryx was also found. Strangely, one of its horns was missing.

"By 9:30 in the morning the day's search was over. The sun obliterates the shadows of the spoor, and, if the animal should be found, we would not be able to chase it without risk to its life in the 120° shade temperature. There's nothing to do until evening but to take it easy and enjoy what pleasures of life exist. The other members of the expedition hunched in the shade waiting for the hours to pass until the evening when we could once again pursue our quest. Each



The oryx as "unicorn."

Tests on a member of the oryx herd at the Phoenix Zoo.



The great freezer at the San Diego Zoo, stocked with its hereditary messages, may prove to be the Ark of the 21st Century.

day these hours, the bright hot sunshine, seemed longer, and longer, and longer. The jokes had all been told and the stories as well. Soon there was nothing to do but wait. Each day passed more slowly with discomfort, boredom, and occasional false alarms. The search went on, and on, until finally we began to feel that we were tracking an animal which was really and truly extinct. Our chief guide, Tomatum, was never depressed, though some of us were beginning to feel that we would never sight an Oryx. Then suddenly — success! Monday, May the sixth, 1962 — Oryx Day. The first animal captured was a healthy male. Two days later, we bagged a young female, essential to the breeding herd. And two weeks after the first capture, we got our third and last animal, another male. A fourth Oryx was caught, but died after capture. An autopsy proved it to be wounded by a hunter's bullet.

"Now that the unicorns were captured, the next step was to preserve them. They were flown to Kenya and placed under quarantine for a full year to meet international regulations. This prevents deadly animal diseases from spreading throughout the world at the speed of jet planes. They seemed content in their pens, a double stockade protecting the Oryx from such threats as lions and leopards. The ground between the barricades was treated to kill disease-carriers. Three times predators attempted to invade the compound, but were run off by guards before they could reach the rare animals."

This was the nucleus of a "world herd," the first animals ever captured in the wild specifically for the purpose of rescuing a species from extinction. The next task was to find a safe place outside their native land for the animals to breed and multiply; a new home for the unicorns.

The Shakir-Safair Club International, headed by its then President Maurice Machris,was responsible for finding this new home. The club is an organization of big game hunters who are dedicated conservationists. They made a global search to find a place with the proper desert environment and responsible wildlife management. Their choice was the Phoenix, Arizona, Zoo.

The Club helped to build the new home at the Phoenix Zoo, and also paid for the transportation of the Oryx. On June 24, 1963, two males and two females-the fourth animal had been donated by the London Zoo-arrived at the Zoo to a gala reception. Five more animals were added. H. E. Sheikh Jabir Abdullah al-Sabah of Kuwait graciously donated one female. And through the efforts of the World Wildlife Fund, the late H. R. H. King Feisal of Saudi Arabia contributed two pairs. Now there were nine Oryx.

The real test lay ahead. Would those nine multiply? Or would the hope of Operation Oryx fade and die with them? One female was pregnant, but there was no assurance she would deliver. After a four-month vigil, she did deliver. The first baby Oryx born to the new world herd arrived safely to spur the hope of concerned conservationists.

From the original nine members, the herd at the Phoenix Zoo grew within ten years to thirty-six. This is all the more remarkable when one remembers that although animals brought from the wild may breed in captivity, their offspring may not. Too often, those offspring, removed from their own kind and raised by man, simply do not know how to breed. Yet breeding success in captive Oryx herds may be more possible than previously thought. The original three Oryx brought from Arabia in 1967 to the Los Angeles Zoo have multiplied to twenty-one; while the Oryx at Los Angeles are not part of the world herd, there have been some exchanges of animals with the Phoenix Zoo, to vary the blood lines.

The importance of the Phoenix herd was further underscored by reports of continued losses of Oryx in Arabia. There seemed less and less hope that the few remaining wild Oryx could sustain the species.

Further safeguards remained to be taken, however. What if disease should strike the Phoenix herd? It could be wiped out, and with it, the hope of survival for the Oryx. This realization led to another landmark decision. Six animals were moved to a new home — San Diego Zoo's Wild Animal Park in Southern California. There, by providing an environment as close as possible to the natural one for animals, the park has been exceptionally successful in wild animal reproduction. Fifteen of the nineteen endangered species in the park have already reproduced there. As for the Arabian Oryx, by 1975, the known world count of captive animals in breeding herds stands close to one hundred: forty-one in Phoenix, ten in the San Diego Zoo Wild Animal Park, twenty-one in the Los Angeles Zoo, and thirty in the private herd of Sheikh Qassim Bin Hamad Al-Thani of Qatar, Arabian Gulf. One day, it may even be possible to reintroduce the Oryx into its native habitat on the Arabian peninsula.

But what of the Ark of the 21st Century? It is now under construction at the San Diego Zoo, the project of Dr. Kurt Benirschke, Director of Research there, and a noted reproductive medicine expert. He is building a bank-the modern-day Ark, if you will - of frozen samples of blood, skin patches, tissue cultures, even semen for future artificial insemination, from many vanishing species at the Zoo. These frozen samples are being put into liquid nitrogen to be held for the future for up to one hundred years. It is even possible to freeze embryos, for future transplant into foster wombs where they might develop to point of birth. The frozen samples of blood and tissue carry the chromosomes, the hereditary fate of the original animal. Sometime in the future by studying the chromosomes and by having an animal's unique genetic structure available, scientists might even be able to recreate that animal. Thus the great freezer in the San Diego Zoo, stocked with its frozen hereditary messages, might just prove to be the Ark of the 21st Century.

In the case of the Arabian Oryx — perhaps the unicorn of legend — man has proved that with good intentions and good planning and international good will, Doomsday can be denied. Man can change destiny.

Who knows what this same spirit of universal cooperation might accomplish for the many other endangered species?

This is the hope of the Ark of the 21st Century. This is the dream of these modern Noahs.

The text of this article has been condensed by a TERRA editor, Katie Schwarzenbach, from the shooting script and narration of Ark of the 21st century, written by Milton Moline and George Van Valkenberg, McDonald Douglas Corporation, Film and Television Communications Department G 83. The film was produced by Machris Productions.

The Great Roman Fish Mystery

by **Dorothy H. Seligman**

Dr. Jiří Frel, Curator of Antiquities at the J. Paul Getty Museum in Malibu, California, has fallen in love with 127 miniature Roman fish, cast in lead around the second century A.D. It is an intellectual love affair that began about three years ago.

The affair surfaced last spring when Dr. Frel was guiding his study group in Greco-Roman sculpture through the Getty's antiquities conservation laboratory. He paused before a panel on which were glued what seemed to be three separate schools of tiny lead fish.

"It's funny to see 127 fish fixed to a panel, isn't it?" Dr. Frel asked. Such is the power of the personality of the man whose classic features and tousled grey curls make him resemble the Roman portrait heads he describes that the class nodded eagerly and pressed in to look.

"Let me tell you their story," said Dr. Frel in his cadenced Czech accent which makes one listen harder, "and I hope it will have a happy ending."

"Some three years ago I saw in the German art market a funny box with little lead fish in it. I asked the dealer about their history and he said, 'I just took them on commission from an old lady whose husband around World War I was building railways from the Balkans to Baghdad. He had this collection of fish which I think I will resell one by one.'

"Well, when I heard this," Dr. Frel continued, holding up the panel for everyone to see better, "I felt it was something very heartbreaking because looking at the 127 fish it is evident that they go together. Selling them one by one can make a better profit for the dealer, but from the point of view of scholarly research, of precious evidence, that's the end of it all! It's quite evident that these fish must have been one deposit, probably a votive offering by fishermen, or something of the kind.

"Whereas I know little about fish from the standpoint of an ichthyologist, it's clear that there was some effort to depict the differences as perhaps they existed in nature. Thus the interest may not be only from an art history and a cultural history point-of-view but of distinct information about what kind of fish were living in the eastern Mediterranean and around the Black Sea in the second or third century A.D.

"The logical thing would be to get them into a museum, the Getty Museum, in California, under our wing to study them and pinpoint their origins. But the Getty Museum doesn't collect minor art, and while the late founder, Mr. Getty, was very interested to see the fish and allowed me to take them on loan from the dealer, he was less enthusiastic about buying them. Thus the normal thing now would be to find somebody who would be interested in seeing that the collection is kept together so that we can find it worthwhile to study them. It would be an enormous waste of our time to give them exhaustive tests if we did not own them."

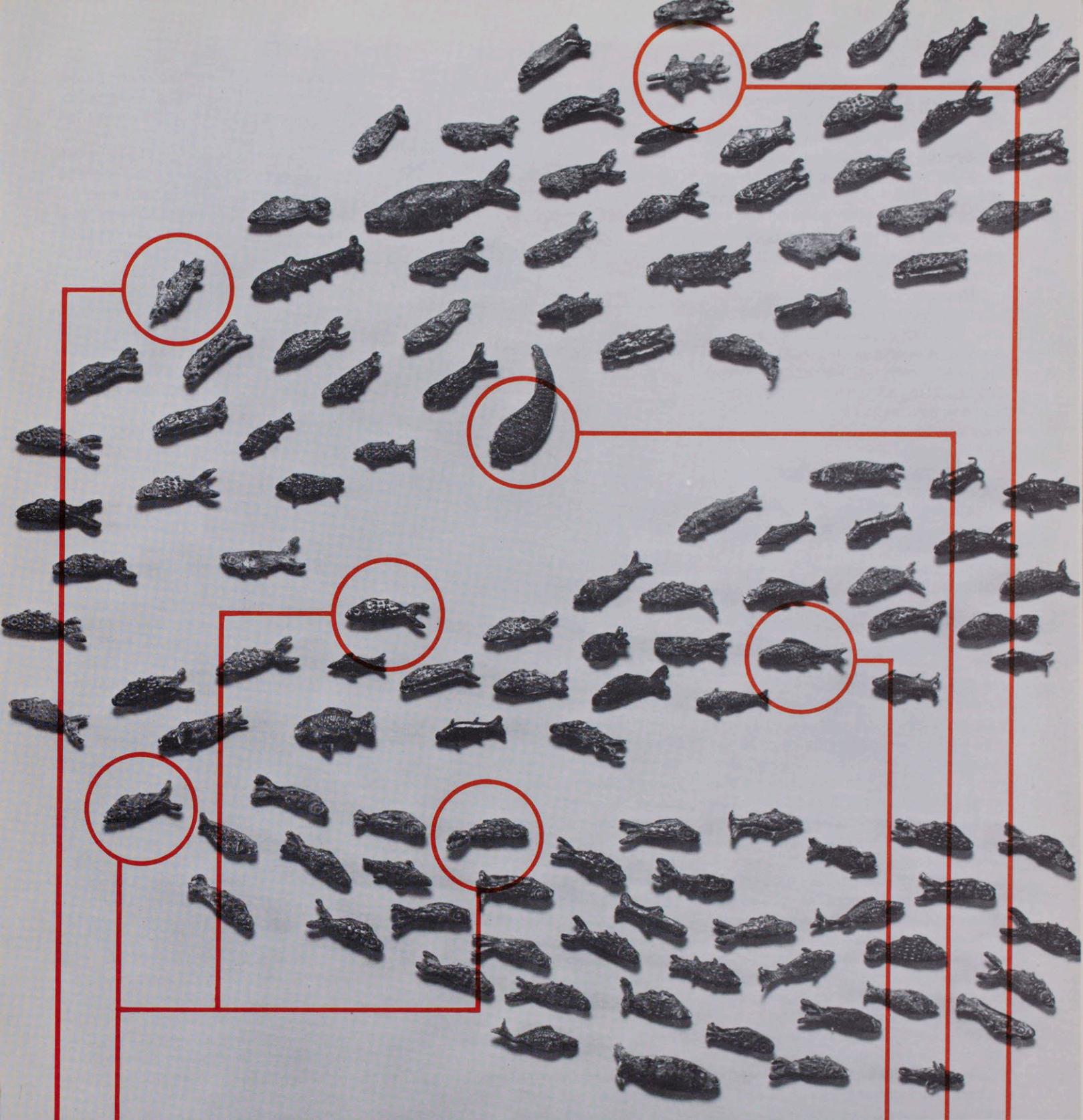
Dr. Frel's eloquence brought the small bronze-colored fish to life and numerous differences in them were noted. TERRA's editor was among the group and offered to try to interest the Natural History Museum's ichthyologist, Dr. Robert Lavenberg, in examining the fish.

Being a man of exceptional intellectual curiosity, Dr. Lavenberg was willing. He used a day-off to make the trip to the Getty Museum for a first-hand examination of the fish. Intrigued, he suggested that they be photographed to exact scale, (no pun intended) so that he might study the fish casts for possible identification whenever he could take the time. He was so busy with Natural History Museum projects, including being curatorial supervisor of the new Hall of Marine Biology under construction, that he couldn't promise when that would be. Soon, he thought.

"Soon" stretched into summer and Dr. Lavenberg was off to meetings in Alaska. TERRA's editor grew impatient and went to see David Rinne, the Getty Museum's Conservator of Antiquities, to ascertain what sorts of tests would be so time-consuming in studying the fish — and what they would prove anyhow.

Mr. Rinne's conservation laboratory was filled with Greek and Roman sculpture in various stages of cleaning and repairing, a thin film of plaster dust, and the strains of a Mozart concerto emerging from a tape recorder in the corner. Two young assistants in smocks were working opposite each other at a long table. Mr. Rinne, chunky body amply filling his overalls, was perched on a stool absorbed in repairing the bust of a Roman matron "with a little mend, fill, and in-painting," as he put it. He didn't pause from his task as he graciously agreed to explain about the fish tests.

Mr. Rinne combines scholarship, humor, and enthusiasm with a staccato beat; thus it was fortunate that a tape recor-



The 127 miniature Roman fish affixed to their panel.

The most common of the fish casts, a type of herring.

An example of a porgy-like fish.

Unknown

Second most common type of fish cast, 14 in number, species undetermined.

Probable moth fish.

der was on hand to ingest the information that spewed forth as he continued to work steadily.

"There are several levels of testing we might be concerned with if we had the time. We'd test the fish for their trace elements and we could do that by taking tiny samples and running them in an emission spectrograph which would give us a very good trace element counting; and we could group them by trace elements alone.

"We could, on the other hand, run them in an atomic pile with neutron activation to see what their total mass composition was, the major constituents of the fish. Or we could separate them by lead isotopes; Dr. Robert Brill at Corning is the expert on that subject and has a mass spectrometer which he uses to separate things by isotopic number, by the weight of the nucleus.

"We might isolate the mine from which the lead comes, if that was important. In all of these things it's a matter of having the information and trying to use all kinds of data with no meaning whatsoever. You could find that every one of the fish was different, that they come from simply everywhere. You could find they come in distinct groups; of course once we know what the compositional groupings are we start to look for design elements which are similar. For craftsmen, say, who did the designs.

"We could examine the fish metallurgically to see whether they were cast and then worked afterwards. We could look at the structure of the lead to see if there were dendrites and so forth, to judge how they were made with a mold. We could check the surface qualities of the fish to see how the decorative lines are applied, whether they were stamped in, whether the fish were literally coined, or whether they were cut with a burin, that is, engraved or incised with whatever instrument.

"We could also look at the fish through an electron microscope. We could see if there was any typical characteristic from one group to the next, as far as working of the surface is concerned.

"We could do a great deal to look at the effect of the lead going over to its carbonates. A lot of the fish appear to be brown and this is probably a collection of lead carbonate, white lead, mixed with soil to make it brown."

Mr. Rinne stopped talking and repairing at the same moment. He tapped a small palette knife against his cheek, gave us a wicked smile and asked, "Is that what you wanted to know?" He'd talked some two minutes without seemingly pausing for breath and he sensed a lack of understanding about nine-tenths of what he'd said.

Reproduced the exact size of actual fish and identified from top to bottom:

Herring.

Porgy-like fish.

Probable moth fish.

Undetermined species, 14 in number.

"That's just great," we told him, not admitting a thing. "It really explains how complicated it all is."

The final step in the great Roman fish mystery was to secure Dr. Lavenberg's report. He'd returned from Alaska and was working at Catalina. Finally, yesterday, we elicited the following report from him:

"The detailed sculpturing of body shape, head, eye, fins and scales clearly indicates the possibility that the Roman fish casts were modeled from actual fish. However, it seems apparent that much artistic liberty was exercised in the conceptualization of the model from the actual fish. The most common type is represented by eighty-four casts; the next most common by fourteen. Some of the fish casts indicate surprisingly little wear, others are well-worn. Yet however much the wear, each of the 127 may be distinguished and categorized into one of fifteen different types.

"The most common fish casts, those eighty-four, appear to be that of a type of herring, even though it is not accurate in all details. The distinguishing characters include a well-modeled head with a large eye, and a mouth with a well-developed gape. Also, the body is elongate, a single dorsal fin is present and small, and the caudal fin is forked, all characters typical of herring. What appear to be three or four projections on the ventral midline may be an artist's representation of scales arranged in such a manner to form a keeled edge. Scales forming a keeled abdomen in the *Clupeidae* (the herrings and their allies) are well-known. There are five kinds of *Clupeidae* in the Mediterranean and it is not possible to select one of these as a basis for the presumed model of the herring-like fish cast.

"Of the remaining fourteen kinds of fish casts there appears to be one that might be a representation of a *Sparidae,* a porgy. The features of the cast that resemble a porgy are the general shape, the elongate dorsal fin, which may be divided, and a small posterior-placed anal fin. These characters hold for other types of bony fishes as well, but porgies seem to fit best. There may be as many as fourteen species of porgies living in the nearshore waters off Italy today, and it would be difficult to proceed further without a great deal more research.

"Another curious fish cast among the 127 is one that clearly resembles a mothfish, *Pegasus,* whereas all the others remain difficult to identify.

"There are about 435 species of fishes that occur off the coast of Italy today, ranging in habitat from the nearshore intertidal into the extensive near-surface oceanic and great deepwater realms. From an examination of the fish casts there appear to be none that is modeled after any of the many kinds of deepsea species. Further, of the more than sixty kinds of sharks and rays in the Mediterranean none is represented in the casts.

"All of the casts seem to represent one or another of the numerous kinds of bony fishes. Even among the many kinds of these bony fishes, there are no representatives of eels, cod, tuna, or flatfishes in this collection of fish models.

"That leaves us with one definite conclusion; the main theme that seems to recur throughout these fish casts is that they represent models of fishes that lived nearshore, and which, further, may have been commercially exploited."

"Commercially exploited," Dr. Frel exclaimed on reading Dr. Lavenberg's report. "You see, by that he means fished for and eaten. That is a link to my theory that they were votive offerings by fishermen. When the Getty Museum owns these fish — how I hope for this — we will get further studies from an ichthyologist-historian."

In the meantime, the panel of 127 fish is on display at the Getty Museum. Those interested in further exploration of the great Roman fish mystery will want to view them in person.

Dorothy H. Seligman, TERRA's editor, put together this article because she wants the Roman fish to find a permanent home at the Getty Museum.

California's Newest Ancient Pronghorn

by **Wade E. Miller**

Paintings by Joseph Nakanishi

In what is now the northwest corner of Los Angeles County, a small river wends its way along the base of a cliff, separating an elevated flatland from the one at water's level. Several tapirs are standing in the quieter water while a group of rhinoceroses are browsing nearby. Further downstream a number of elephant-like animals have just emerged from a wooded area and are now ambling toward the river to bathe. Feeling threatened at their approach, a turtle pushes into the water. Above the cliff, which is nearly fifty feet in height, a grassy expanse extends a few hundred yards before being interrupted by a wooded area. A small herd of pronghorns grazes warily on the grass not far from the cliff's edge. Between this band of small, horned animals and the woods is a modest-sized herd of horses. As they graze, the horses are making intermittent progress toward several resting camels which appear to be unconcerned at the intrusion. Three giant tortoises bask in the sun, confident of the safety provided by their thick shells. Of all the animals depicted, only the pronghorns show signs of fear. This fear is indeed well-founded.

Unknown to the other inhabitants of the above scene, a pair of jaguar-like cats have recently come hunting into the area. Not being sufficiently cautious in their last foray, these cats had frightened their prey before

making a well-coordinated attack. As a result, the small herd of pronghorns escaped unscathed. But driven by hunger, the pair, using greater caution surreptitiously have followed the herd.

From the edge of the woods where they are well-hidden, the cats view the grassy expanse to its termination at the cliff. Several new food sources catch their gaze; however, experience has taught them that the original prey will be easier to bring down. A finger-like projection of the wooded area in the form of a few trees and many bushes affords a cover that extends far onto the grassland. It ends about fifty yards in front of the small, horned grazers. Using this cover the two large cats stealthily creep to its terminus. As if on signal they bound toward the herd from separate vantage points, realizing the cliff will limit any escape route and that from their angle of attack at least one of them should meet with success.

The herd, already nervous as the cats assault, disregards the second danger and gallops perilously close to the edge of the cliff. Undercut to the point of collapsing under its own weight, a section at the edge of the cliff gives way under the additional stress and half the herd falls with it. Surprised by the unexpected event and startled by the noise, the predators, hunger forgotten, race for the safety of cover. With the exception of the lethargic tortoises, the grassland's previous inhabitants have all quickly vanished. The reactions are not yet over. As the section of cliff descends with its hapless prey, the noise resounds through the valley below. Even before the dust has fully risen the rhinoceroses and elephantine animals have charged for cover and the band of tapirs swims frantically downstream. Then there is total silence.

All eleven of the pronghorns caught in the landslide perish. Due to the slide's inertia, six of them are carried far enough into the river to be swept downstream, while the remaining five lie partially submerged in quiet water. Time passes. Then, seemingly from nowhere, vultures appear and swoop down upon the carnage. Almost mechanically these aerial scavengers effectively strip the carcasses to their bony framework. In an attempt to tear away the remaining bits of meat, contending for the choicest morsels, the vultures disassemble the five skeletons. Feeding ceased, the bones are left in a state of disarray, and one by one the large birds, with difficulty, become airborne and fly to safer reaches.

With passing time the skeletal remains of the pronghorns are covered in sand by the relentless work of the river. The last vestiges of soft tissue have already been removed by microscopic organisms so that only the resistant bone testifies to the pronghorns' existence. Each passing year finds the bones more deeply buried. The bones, now resting in their sandy enclosure, have become brown-stained by the same compounds that have covered each sand grain. With the advancing millennia the ground waters carrying dissolved minerals have even replaced some of the bone and filled cavities with their stony substance.

Profound changes now affect the entire area. As one crustal plate of the earth's surface is pushed under another, it causes the upper one to fold and fracture; the Transverse Ranges, including the Santa Monica, Santa Susana and San Gabriel mountains, are being formed. The sands that encase the fossil bones have been turned into sandstone and are now highly tilted. Even the bones themselves bear witness to the

Sandstone slabs from which the new pronghorn was recovered.

View of three sandstone slabs showing new pronghorn. Horned skull, nearly upside down, can be seen in lower right section, and jaw in lower left. Miscellaneous bones occur in all three sections.

ordeal as they are replete with tiny fractures. As pulses raise the land higher, streams form and carve new valleys, and in the forming of one of these valleys the sandstone is cut to such a depth that the bones that had so long been hidden are exposed.

Although the story just related is largely fictitious, many of the basic elements are true; and in fact the story itself could have happened. Fossil evidence of all the animals mentioned was found in the northwest portion of Los Angeles County with the exception of the vulture, which is known from deposits of the same age in adjacent Kern County. The habitat depicted in the story is substantiated both by the types of fossil animals collected, and by fossil plants which have been recovered several miles to the south near Piru. Upturned rock beds at the site are evidence of their being involved in the mountain building which affected much of California in the past several million years.

The fossils were found either in sandstone (such as those of the pronghorn shown in photographs) or had weathered from this type of rock as separate entities. No radiometric dates are available for the sandstone or the fossils, but the types of animals represented suggest an age of approximately six million years. This approximation is obtained by comparing the species of the animals discovered here to similar ones from other deposits where a radiometric date, based on radioactive substances, has been determined. Another method of dating is to compare the evolutionary stage of development of one species of unknown age with a similar one of known age. For example, the new pronghorn discussed in this article compares favorably in its stage of development with others of known Pliocene age. Thus, the age of the present pronghorn is considered Pliocene (this is substantiated by the other fossil animals). More ancient pronghorns had a circular horn core, usually several inches high, which showed a simple branching and thereby resembled the antlers of a young deer. Also, primitive types had teeth with relatively shorter crowns. More recent pronghorns mostly had horn cores which branched nearer their bases than did the pronghorn discussed in this article, or else did not branch at all. And, their teeth had relatively longer crowns while the roots showed greater fusion.

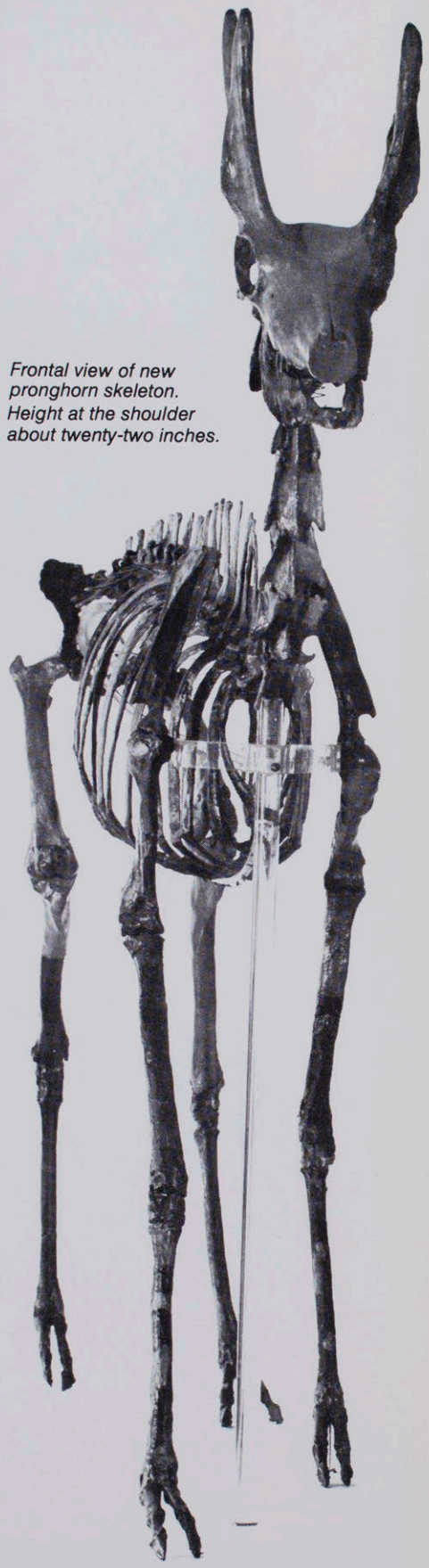
Many of the animals mentioned in the opening story appear to be out of place in Los Angeles County, or North America for that matter. The setting might have been in Africa. Nevertheless their fossils attest to the fact that they did indeed live in California. Persons familiar with the fauna of Rancho La Brea know that horses, camels, tapirs, jaguar-like cats and close relatives of the elephant lived in southern California until several thousand years ago. The rhinoceros was also abundant in North America at one time, but became extinct here about five or six million years ago. These animals have been known to science for many decades. It is the pronghorn which deserves the starring role in this story. Pronghorns, which are mistakenly called antelopes by most people, are known only from North America; this includes all fossils as well as living forms. Although this family has long been recognized in the fossil record, the type mentioned in this article is new to science. Thus far this new pronghorn is known only from the area in northwestern Los Angeles County. However, based on the geographic ranges of related types, it probably existed in many of the western states and possibly Mexico.

Mr. William Davidson, a geologist for the Standard Oil Company of California, was inspecting an area in Coyote Canyon on the G. E. Kinsey Ranch when he found many disarticulated fossil bones in a sandstone slab. This discovery was reported to Mr. Howard Anderson, also of the Standard Oil Company, who wisely brought the fossiliferous rock to the Natural History Museum of Los Angeles County. Contained within this sandstone block were the bones of a previously unknown animal: the new pronghorn had been discovered.

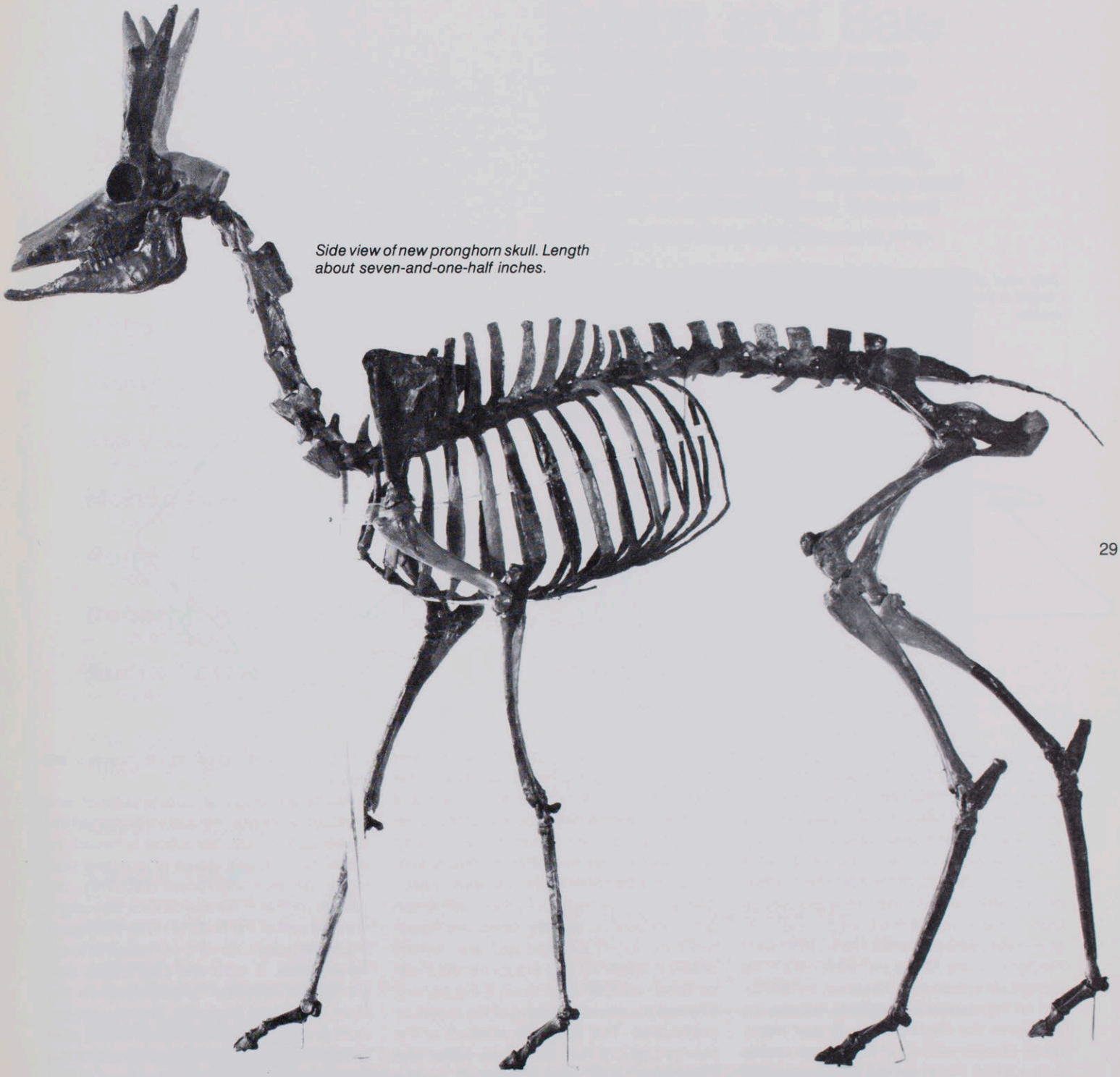
The scientific name of the new pronghorn is *Ottoceros peacevalleyensis*. Etymologically, the first or generic name was derived from two sources. The first part of the generic name, "Otto", was given in honor of William J. P. Otto, a former preparator at the Natural History Museum of Los Angeles County who spent numerous hours carefully working the fossil pronghorn bones out of the standstone in order that they might be studied properly. "Ceros" is from the Greek word "Keros", which means horn, referring to the fact that the animal was of a horned variety. The second or species name, *"peacevalleyensis"*, comes from the area where the animal was discovered, which was Peace Valley.

The actual finding of the pronghorn fossils was not the end of the story, but rather the beginning. This is true of all paleontological finds. During the time fossils are being collected it is important to record data concerning the geology as well as the paleontology. The type of rocks in which fossils are found gives important information about ancient environments and possibly age. The

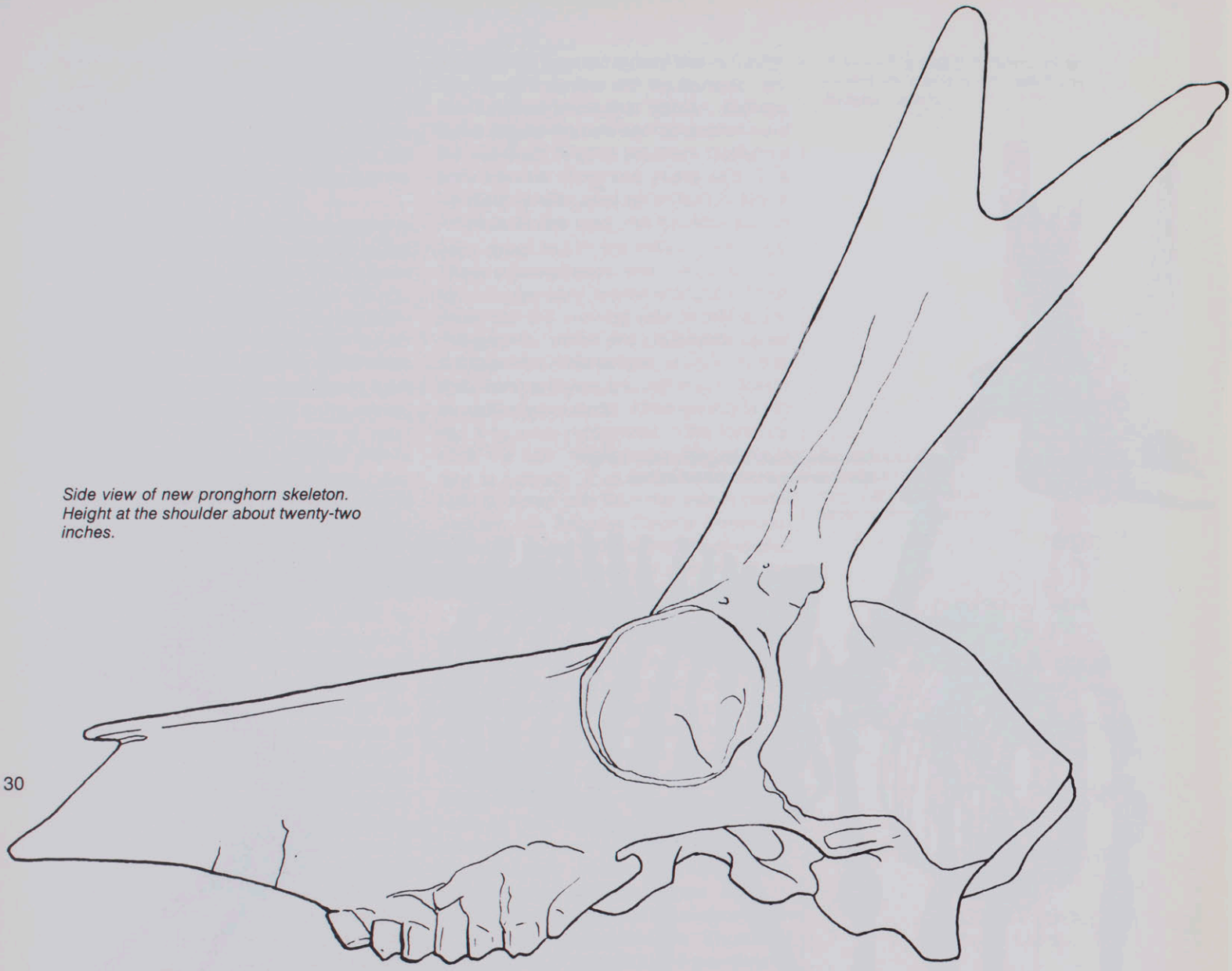
(Preceeding page) Picture portraying ancient life scene in northwest Los Angeles County.



Frontal view of new pronghorn skeleton. Height at the shoulder about twenty-two inches.



Side view of new pronghorn skull. Length about seven-and-one-half inches.



Side view of new pronghorn skeleton. Height at the shoulder about twenty-two inches.

exact position of fossils in the rocks is important because one found a few feet higher than another could be millions of years younger, depending upon the erosional and depositional history of the region. The fossils related in this article, such as the tortoise, tapir, horse, rhinoceros, camel, which were found on the ground surface already weathered from the rock, required very little preparation after they were brought to the Museum. Almost all the pronghorn specimens, however, were matted in hardened sandstone blocks as shown in the illustrations. It took many hours of work with small hand instruments to free them. Following the preparation, it is common procedure to take detailed measurements of bones and teeth. It is not uncommon to take six or more measurements from a single bone or tooth. Fossils are then compared, often on a bone-by-bone (or tooth-by-tooth) basis, with similar fossils of known animals from other localities and those given in the scientific literature. This was done for most of the 464 bones and teeth of the new pronghorns. Depending upon the number of specimens being studied and those available for comparison, this phase can take months or even years. Sometimes the fossils used in comparison are from another country. Important fossils are carefully illustrated and are usually drawn to scale so that measurements can be taken directly from them if necessary. The last phase is the writing of the report for publication. The scientific account of the new pronghorn was written by Miller and Downs in 1974, and appeared as the Natural History Museum of Los Angeles County's "Contributions in Science", number 258. More often than not numerous drafts with many revisions are necessary before an acceptable finished product results. Even then the work may not be final, as some part of the research may warrant further study.

Many people, both professional and amateur, were responsible for finding all the fossils upon which this article is based. Interestingly enough, it was an amateur who made the most significant discovery, the new pronghorn. All specimens described are now part of the Natural History Museum of Los Angeles County's collection of fossil vertebrates. A mounted cast of the new pronghorn skeleton is displayed on the main floor of the Museum. The newest ancient pronghorn is known once more, after being buried for millions of years under the Southern Californian landscape.

Wade E. Miller teaches in both the Departments of Zoology and Geology at Brigham Young University. He is also a Research Associate at the Natural History Museum of Los Angeles County.

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